

WHAT IS CLAIMED AS NEW AND IS DESIRED TO BE SECURED BY
LETTERS PATENT OF THE UNITED STATES IS:

1 A fixing apparatus, comprising:

5 a heater having a line shape orthogonal to a direction
in which a recording sheet carrying an unfixed toner image
formed with toner in accordance with image information is
transferred;

an endless belt configured to be rotated with an inner
10 surface thereof sliding over a surface of said heater;

a pressure roller arranged at a position opposite to
said heater relative to said endless belt, said pressure
roller being held for rotation in contact with said endless
belt under pressure to form a nip therebetween; and

15 a heater controller configured to energize said heater
in accordance with said image information,

wherein, when said recording sheet is brought to said
nip with said unfixed toner image facing said endless belt,
said pressure roller applies pressure to said recording sheet
20 against said endless belt so that said unfixed toner image is
fixed on said recording sheet with heat by said heater as
said recording sheet is transferred by movement of said
endless belt and said pressure roller.

25 2. A fixing apparatus as defined in Claim 1, wherein

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said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10¹³ [c poise] under a temperature above said
5 softening or melting point.

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3. A fixing apparatus as defined in Claim 1, wherein said heater includes at least two parallel heating elements, each of which has a line shape orthogonal to said direction
10 in which said recording sheet is transferred.

4. A fixing apparatus as defined in Claim 3, wherein said heater controller alternately energizes said at least two parallel heating elements with alternating pulses.
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5. A fixing apparatus as defined in Claim 3, wherein said at least two parallel heating elements are distant from each other by 10 mm or less.

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20 6. A fixing apparatus as defined in Claim 2, wherein each of said at least two parallel heating elements has a width in a range between 0.01 mm and 5 mm.

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25 7. A fixing apparatus as defined in Claim 1, wherein said heater includes a plurality of heating elements arranged

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comprising a mechanism configured to cause said endless belt to tightly hold said toner image and said recording sheet together until said toner image is fixed on said recording sheet after said toner image is subjected to the heat of said heater.

13. A fixing apparatus as defined in Claim 1, wherein said heater controller stops energizing said heater during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

14. A fixing apparatus as defined in Claim 1, wherein said heater controller energizes said heater during a time when a region of said toner image in said recording sheet is brought close to said heater.

15. A fixing apparatus as defined in Claim 1, wherein said heater controller energizes said heater with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

16. A fixing apparatus, comprising:

heating means for heating an unfixed toner image formed with toner on a recording sheet in accordance with image

information, said heating means having a line shape
orthogonal to a direction in which said recording sheet is
transferred;

endless belt means for being rotated with an inner
5 surface thereof sliding over a surface of said heating means;

pressure roller means for being held for rotation in
contact with said endless belt means under pressure to form a
nip therebetween, said pressure roller means being arranged
at a position opposite to said heating means relative to said
10 endless belt means; and

heater controlling means for energizing said heating
means in accordance with said image information,

wherein, when said recording sheet is brought to said
nip with said unfixed toner image facing said endless belt
15 means, said pressure roller means applies pressure to said
recording sheet against said endless belt means so that said
unfixed toner image is fixed on said recording sheet with
heat by said heating means as said recording sheet is
transferred by movement of said endless belt means and said
20 pressure roller means.

17. A fixing apparatus as defined in Claim 16,
wherein said toner includes a resin as a main adhesive agent
and has properties of a softening or melting point in a range
25 between 50°C and 160 °C and a viscosity in a range between 10

32 [c poise] and 10^{13} [c poise] under a temperature above said softening or melting point.

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18. A fixing apparatus as defined in Claim 16,
5 wherein said heating means includes at least two parallel heating elements, each of which has a line shape orthogonal to said direction in which said recording sheet is transferred.

10 19. A fixing apparatus as defined in Claim 18,
wherein said heater controlling means alternately energizes said at least two parallel heating elements with alternating pulses.

15 20. A fixing apparatus as defined in Claim 18,
wherein said at least two parallel heating elements are distant from each other by 10 mm or less.

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21. A fixing apparatus as defined in Claim 17,
20 wherein each of said at least ^a two parallel heating elements has a width in a range between 0.01 mm and 5 mm.

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22. A fixing apparatus as defined in Claim 16,
wherein said heating means includes a plurality of heating
25 elements arranged in line in a direction orthogonal to said

direction in which said recording sheet is transferred.

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23. A fixing apparatus as defined in Claim 22,
wherein each of said plurality of heating elements includes a
5 thermal head.

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24. A fixing apparatus as defined in Claim 21,
wherein said heater controlling means selectively energizes
said plurality of heating elements.

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25. A fixing apparatus as defined in Claim 16,
further comprising cooling means for cooling said toner image
after said toner image is fixed with heat by said heating
means on said recording sheet.

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26. A fixing apparatus as defined in f Claim 16,
further comprising guide roller means for supporting said
endless belt means and serving as cooling means for cooling
said toner image after said toner image is fixed with heat by
20 said heating means on said recording sheet, said guide roller
being arranged at a position downstream from said heating
means in said direction in which said recording sheet is
transferred.

25 sub D2 27. A fixing apparatus as defined in Claim 16,

further comprising means for causing said endless belt means to tightly hold said toner image and said recording sheet together until said toner image is fixed on said recording sheet after said toner image is subjected to the heat of said heating means.

28. A fixing apparatus as defined in Claim 16, wherein said heater controlling means stops energizing said heating means during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

29. A fixing apparatus as defined in Claim 16, wherein said heater controlling means energizes said heating means during a time when a region of said toner image in said recording sheet is brought close to said heating means.

30. A fixing apparatus as defined in Claim 16, wherein said heater controlling means energizes said heating means with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

31. A fixing method of image forming, comprising the

steps of:

forming a nip between an endless belt and a pressure roller which are held for rotation in contact with each other under pressure;

5 providing a heater at position inside said endless belt, in contact with said endless belt, and opposite to said pressure roller relative to said endless belt, said heater

having a line shape orthogonal to a direction in which a recording sheet having an unfixed toner image formed with

10 toner in accordance with image information is transferred;

rotating said endless belt and said pressure roller, said endless belt sliding over a surface of said heater by rotation;

transferring said recording sheet to said nip, said recording sheet being in an orientation in which said toner image faces said endless belt; and

energizing said heater in accordance with said image information when said toner image is brought to said heater.

20 32. A fixing method as defined in Claim 31, wherein said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10¹³ [c poise] under a temperature above said
25 softening or melting point.

33. A fixing method as defined in Claim 31, wherein
said heater includes at least two parallel heating elements,
each of which has a line shape orthogonal to said direction
in which said recording sheet is transferred.

34. A fixing method as defined in Claim 33, wherein
said energizing step alternately energizes said at least two
parallel heating elements with alternating pulses.

35. A fixing method as defined in Claim 33, wherein
said at least two parallel heating elements are distant from
each other by 10 mm or less.

36. A fixing apparatus as defined in Claim 32,
wherein each of said at least two parallel heating elements
has a width in a range between 0.01 mm and 5 mm.

37. A fixing method as defined in Claim 31, wherein
said heater includes a plurality of heating elements arranged
in line in a direction orthogonal to said direction in which
said recording sheet is transferred.

38. A fixing method as defined in Claim 37, wherein
each of said plurality of heating elements includes a thermal

head.

39. A fixing method as defined in Claim 36, wherein
said energizing step selectively energizes said plurality of
5 heating elements.

40. A fixing method as defined in Claim 31, further
comprising a cooling step for cooling said toner image after
said toner image is fixed with heat by said heating step on
10 said recording sheet.

41. A fixing method as defined in Claim 31, further
comprising a providing step for providing a guide roller for
supporting said endless belt and for serving as a cooling
15 member for cooling said toner image after said toner image is
fixed with heat by said heating step on said recording sheet,
said guide roller being arranged at a position downstream
from said heater in said direction in which said recording
sheet is transferred.

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42. A fixing method as defined in Claim 31, further
comprising a providing step of providing a member for causing
said endless belt to tightly hold said toner image and said
recording sheet together until said toner image is fixed on
25 said recording sheet after said toner image is subjected to

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45. A fixing method as defined in Claim 31, wherein said energizing step energizes said heater with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

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an endless belt configured to be rotated with an inner surface thereof sliding over a surface of said heater;

5 a pressure roller arranged at a position opposite to said heater relative to said endless belt, said pressure roller being held for rotation in contact with said endless belt under pressure to form a nip therebetween; and

a heater controller configured to energize said heater in accordance with said image information,

10 wherein, when said recording sheet is brought to said nip with said unfixed toner image facing said endless belt, said pressure roller applies pressure to said recording sheet against said endless belt so that said unfixed toner image is fixed on said recording sheet with heat by said heater as said recording sheet is transferred by movement of said
15 endless belt and said pressure roller.

47. An image forming apparatus as defined in Claim 45, wherein said toner includes a resin as a main adhesive agent and has properties of a softening or melting point in a range
20 between 50°C and 160 °C and a viscosity in a range between 10 [c poise] and 10¹³ [c poise] under a temperature above said softening or melting point.

48. An image forming apparatus as defined in Claim 45,
25 wherein said heater includes at least two parallel heating

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elements, each of which has a line shape orthogonal to said
direction in which said recording sheet is transferred.

49. An image forming apparatus as defined in Claim 48,
5 wherein said heater controller alternately energizes said at
least two parallel heating elements with alternating pulses.

50. An image forming apparatus as defined in Claim 48,
wherein said at least two parallel heating elements are
10 distant from each other by 10 mm or less.

51. An image forming apparatus as defined in Claim 47,
wherein each of said at least two parallel heating elements
has a width in a range between 0.01 mm and 5 mm.

52. An image forming apparatus as defined in Claim 46,
wherein said heater includes a plurality of heating elements
arranged in line in a direction orthogonal to said direction
in which said recording sheet is transferred.

53. An image forming apparatus as defined in Claim 52,
wherein each of said plurality of heating elements includes a
thermal head.

54. An image forming apparatus as defined in Claim 51,

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wherein said heater controller selectively energizes said plurality of heating elements. /a

55. An image forming apparatus as defined in Claim 46,
5 further comprising a cooling mechanism configured to cool
said toner image after said toner image is fixed with heat by
said heater on said recording sheet.

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56. An image forming apparatus as defined in Claim 46,
10 further comprising a guide roller arranged at a position
downstream from said heater in said direction in which said
recording sheet is transferred, said guide roller being
configured to support said endless belt and to serve as a
cooling mechanism configured to cool said toner image after
15 said toner image is fixed with heat by said heater on said
recording sheet.

57. An image forming apparatus as defined in Claim 46,
further comprising a mechanism configured to cause said
20 endless belt to tightly hold said toner image and said
recording sheet together until said toner image is fixed on
said recording sheet after said toner image is subjected to
the heat of said heater.

25 58. An image forming apparatus as defined in Claim 46,

wherein said heater controller stops energizing said heater during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

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59. An image forming apparatus as defined in Claim 46, wherein said heater controller energizes said heater during a time when a region of said toner image in said recording sheet is brought close to said heater.

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60. An image forming apparatus as defined in Claim 46, wherein said heater controller energizes said heater with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heater.

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61. An image forming apparatus, comprising:

image forming means for forming a toner image with toner on a recording sheet in accordance with image information;

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heating means for heating an unfixed toner image formed with toner on a recording sheet in accordance with image information, said heating means having a line shape orthogonal to a direction in which said recording sheet is

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transferred;

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endless belt means for being rotated with an inner
surface thereof sliding over a surface of said heating means;

pressure roller means for being held for rotation in
contact with said endless belt means under pressure to form a
nip therebetween, said pressure roller means being arranged
at a position opposite to said heating means relative to said
endless belt means; and

heater controlling means for energizing said heating
means in accordance with said image information,

wherein, when said recording sheet is brought to said
nip with said unfixed toner image facing said endless belt
means, said pressure roller means applies pressure to said
recording sheet against said endless belt means so that said
unfixed toner image is fixed on said recording sheet with
heat by said heating means as said recording sheet is
transferred by movement of said endless belt means and said
pressure roller means.

62. An image forming apparatus as defined in Claim 61,
wherein said toner includes a resin as a main adhesive agent
and has properties of a softening or melting point in a range
between 50°C and 160 °C and a viscosity in a range between 10
[c poise] and 10¹³ [c poise] under a temperature above said
softening or melting point.

63. An image forming apparatus as defined in Claim 61,
wherein said heating means includes at least two parallel
heating elements, each of which has a line shape orthogonal
to said direction in which said recording sheet is
transferred.

64. An image forming apparatus as defined in Claim 63,
wherein said heater controlling means alternately energizes
said at least two parallel heating elements with alternating
pulses.

65. An image forming apparatus as defined in Claim 63,
wherein said at least two parallel heating elements are
distant from each other by 10 mm or less.

66. An image forming apparatus as defined in Claim 62,
wherein each of said at least two parallel heating elements
has a width in a range between 0.01 mm and 5 mm.

67. An image forming apparatus as defined in Claim 61,
wherein said heating means includes a plurality of heating
elements arranged in line in a direction orthogonal to said
direction in which said recording sheet is transferred.

68. An image forming apparatus as defined in Claim 67,

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wherein each of said plurality of heating elements includes a thermal head.

69. An image forming apparatus as defined in Claim 66,
5 wherein said heater controlling means selectively energizes said plurality of heating elements.

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70. An image forming apparatus as defined in Claim 61,
further comprising cooling means for cooling said toner image
10 after said toner image is fixed with heat by said heating means on said recording sheet.

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71. An image forming apparatus as defined in Claim 61,
further comprising guide roller means for supporting said
15 endless belt means and serving as cooling means for cooling said toner image after said toner image is fixed with heat by said heating means on said recording sheet, said guide roller being arranged at a position downstream from said heating means in said direction in which said recording sheet is
20 transferred.

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72. An image forming apparatus as defined in Claim 61,
further comprising means for causing said endless belt means
to tightly hold said toner image and said recording sheet
25 together until said toner image is fixed on said recording

sheet after said toner image is subjected to the heat of said heating means.

73. An image forming apparatus as defined in Claim 61,
5 wherein said heater controlling means stops energizing said heating means during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said heating means.

74. An image forming apparatus as defined in Claim 61,
10 wherein said heater controlling means energizes said heating means during a time when a region of said toner image in said recording sheet is brought close to said heating means.

75. An image forming apparatus as defined in Claim 61,
15 wherein said heater controlling means energizes said heating means with an electric power reduced by 5 % or more during a time when a non-image region between two adjacent toner image lines in said recording sheet is brought close to said
20 heating means.